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Perennial Canker of Apple Trees

(A preliminary report)

By

S. M. Zeller and Leroy Childs

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Fig. 1. A five-year-old perennial canker which started from a pruning cut on a scaffold branch. Notice the woolly aphis where a scale of dead bark has been removed.
Fig. 2. Perennial canker on tiny apple twig showing circular, waxy fruiting bodies breaking through the epidermis. (Magnified 3½ diameters).

SUMMARY

In this bulletin is described the perennial canker of apple trees, a disease which, in some of its stages, is very difficult to distinguish from the apple-tree anthracnose caused by *Neofabraea malicorticis*. The known distribution of the disease ranges from the Okanogan Valley, British Columbia, to the Willamette Valley, Oregon. It has also been reported from the Spokane and Wenatchee valleys in Washington, from certain stations along both sides of the Columbia River, and especially the Hood River Valley, where the disease is well distributed in the upper and lower valleys. The disease differs from apple-tree anthracnose at least in four distinct ways: (1) its perennial character, (2) it is more distinctly a wound parasite than anthracnose, (3) the shape of the conidia, and (4) its reactions on media in culture. Since this disease appears to be undescribed the name **Gloeosporium perennans** Zeller and Childs sp. nov. is proposed and **"perennial canker"** is given as a common or horticultural name.

No preventive measures of control are yet positively known for this disease. However, the liberal use of bordeaux mixture, particularly the spring application of bordeaux-oil, appears to be of some assistance in checking the advance of the disease. In districts where the disease is present pruning should be reduced to a minimum until control measures are better understood. Cuts on the main scaffold branches of the trees should be avoided as much as possible. Eradication measures involve cutting out the diseased tissues and painting over all cleaned-out wounds, whether cleaned-canker wounds, pruning cuts, or other injuries, with an antiseptic wound dressing, preferably bordeaux paste made up in raw linseed-oil.

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INTRODUCTION

For a number of years two distinct apple-tree anthracnoses have been prevalent in the Northwest, but since their distinguishing characteristics had not been recognized the two forms have been grouped under the Northwest apple-tree anthracnose caused by *Neofabraea malicorticis*. For some time considerable difficulty has been encountered in the control of one of these anthracnoses in certain orchards of the Hood River Valley. This led to a more definite investigation of the fungus concerned. As a consequence we have just found this spring (1925) that there are two distinct forms and now are able to distinguish between them, as previously reported.*

The well known apple-tree anthracnose infects during the fall and winter months, producing a canker wherever a spore alights upon the bark. It is a virulent parasite, which does not usually enter through wounds. The newly found anthracnose, which we are calling *Perennial Canker,* enters through wounds and produces a canker around these wounds. This canker grows from year to year, producing new growth around the older canker, so that there is a definite annual canker enlargement. On the other hand, the well known anthracnose grows for one year in the healthy bark, the wound callusing over and the disease not extending itself into the surrounding healthy tissues during succeeding years, except where new infections take place near the margins of old cankers. Those who have had experience in controlling anthracnose believe that the two conditions, biennial and perennial canker, have been with us for a considerable time preceding the records we now have.

DISTRIBUTION AND OCCURRENCE

The geographical distribution of the perennial canker in the Pacific Northwest so far as we have learned at present is pretty well over the apple growing districts of Oregon, Washington, and British Columbia. In Oregon this canker has been found to occur in many parts of the Willamette Valley, it having been received from Brownsville, Corvallis, Monroe, and Salem. In the Hood River Valley it has been found to occur throughout the upper and lower valleys. In Eastern Oregon, specimens have been received from the Milton-Freewater, The Dalles, and Mosier districts. The canker also occurs in the Wenatchee, White Salmon, and the Spokane valleys as well as Clark and Skamania counties of the state of Washington, and in the Okanogan district of British Columbia. In all of these districts the canker is becoming more prevalent and a rather serious disease in those orchards affected.

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*Zeller, S. M. and Childs, Leroy. Another apple-tree anthracnose in the Northwest and a comparison with the well known apple-tree anthracnose. Paper presented before American Phytopathological Society, Pacific Division. June 23, 1925. (Abstract to appear in Phytopathology.)

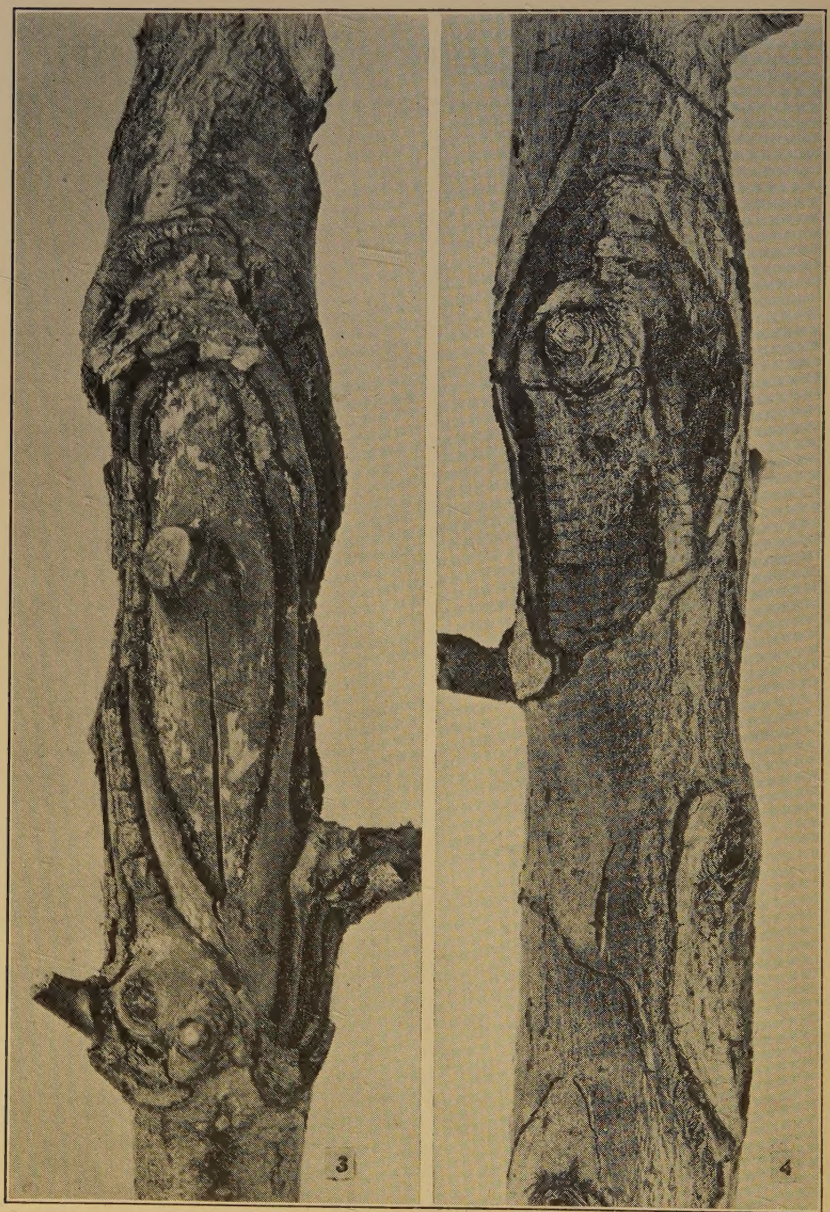


Fig. 3. A five-year-old perennial canker. Notice the concentric annual growth rings.
Fig. 4. Showing three-year-old and two-year-old perennial cankers with diseased bark still adhering.

The occurrence of the canker on different hosts has not been surveyed adequately, but some observations have been made concerning the varieties susceptible, as far as this can be determined by prevalence of the canker. In the Hood River Valley the predominant susceptible variety is the Newtown Pippin, followed in order of susceptibility by the Ortley, Gravenstein, Jonathan, and Winter Banana. The Delicious, Arkansas Black, Black Twig, and the Winesap, appear to be quite resistant to the disease in the Hood River district. The Baldwin also appears to belong to this group as this variety has been observed situated among severely cankered varieties without developing infection. In the Willamette Valley the canker has been found on Newtown and Delicious apples, and the Bartlett pear. On the last mentioned variety the cankers were limited to last year's wood, such as water sprouts or suckers from the base of the trunk. Mr. D. F. Fisher, Plant Pathologist, of the United States Department of Agriculture, stationed at Wenatchee, Washington, reports that in the Wenatchee Valley, Spitzenberg trees are the ones affected by this canker, while neighboring Winesap trees are free from canker.

TIME OF APPEARANCE

The information we have at this time concerning the time of appearance of the canker is rather meager. We do know, however, that conidia are liberated in the spring. This spring (1925) the acervuli opened early in May and continued to liberate spores until in the month of June. Last year an apple grower in the Hood River Valley stripped off the water sprouts along the larger scaffold branches of his trees during the latter part of May and the first part of June. This year nearly every wound produced in this way is the center of a perennial canker. Presumably, then, infections take place during the spring, but the time of canker enlargement is still in doubt; although, since definite calluses fissure the bark at the margins of cankers during the spring months we anticipate that canker enlargement must take place during the fall and winter or at least very early spring as in the case of apple-tree anthracnose. It would appear, then, that infection taking place in the spring is followed by a hibernation of the mycelium during at least a portion of the summer and then a development of the fungus after the rains begin, with the maturity of acervuli coming in the spring. With addition of moisture the acervuli are easily rejuvenated and caused to sporulate in the laboratory. For this reason it is assumed that with the first rains in the fall months sporulation may be resumed for a time and possible infection may take place then.

RELATION TO BARK AND TWIG LESIONS

The occurrence of cankers on a tree bears a definite relation to various types of wounds. Pruning wounds invaded by the fungus appear to be the location of the greatest number of cankers, particularly those located on the scaffold branches of the infected tree. (Figs. 1, 3, and 6.) These wounds appear to be especially liable to infection following extremely low temperatures and infestation by woolly aphis. Other common locations of infection are broken twigs and spurs (Figs. 9 to 12), pickers' scars and injuries produced by propping up the branches. All injuries to the bark apparently become possible centers of infection. Where woolly aphids produce lesions along water sprouts these lesions are sure to be infected in badly cankered

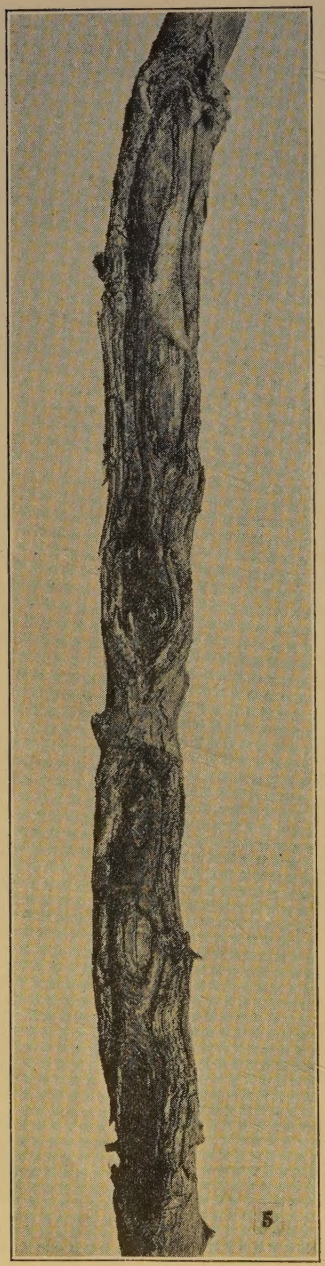


Fig. 5. A badly cankered Newtown branch.

orchards (Figs. 7 and 8). Many water sprouts found on cankered trees are infected throughout their length because of the previous injury by aphids. A canker often forms on the branch at the base of a killed water sprout.

Judging from the width of the growth areas of canker following the extremely low temperatures of December, 1919, and the winter of 1924-25, it is rather apparent that this canker is worse during the years following extreme winters. As in the case of bitter-rot,* this canker infects and lives over in other types of cankers, such as the Northwest apple-tree anthracnose (Fig. 5) and European canker. Since the apple-tree-anthracnose canker may be bordered with a ring of diseased bark-tissue invaded by the perennial canker fungus, it has been thought by some that during the springs following cold winters the apple-tree anthracnose continues to grow in the bark surrounding old anthracnose cankers. Thus there has been in the past a confusion of the two diseases. This may be the unusual perennial condition to which Jackson has referred and also may be the grounds for Mr. Lownsdale's contentions cited by Jackson.** The fact that the perennial canker infects through wounds is one of the predominant distinguishing characteristics between this canker and the apple-tree anthracnose. The accompanying illustrations show some of the typical cankers surrounding wounds of various causes (Figs. 1 to 12).

GENERAL DESCRIPTION OF THE CANKER

Cankers are found on branches of various sizes, from last year's wood up to branches of five to six inches in diameter in vigorously growing trees. Cankers are rarely found below the main crotches in the scaffold branches, except in such instances when trunks have suffered winter injury. In such cases the disease spreads rapidly making winter injury a real menace to the life of the whole tree. The very earliest stages of the canker appear con-

*Roberts, J. W. Sources of the early infections of apple bitter-rot. Jour. Agr. Res. 4:59—64. 1915.

**Jackson, H. S. Apple Tree Anthracnose. Ore. Exp. Sta. Crop Pest and Hort. Rept. 1911—1912:178—197. 1913 (See page 193).

siderably lighter than in the case of apple-tree anthracnose. The color of the canker depends considerably on the age of the bark and seems to vary with climatic conditions in different localities. Cankers on very young water sprouts or on one-year-old wood have a light tannish-brown appearance, with a glassy surface. This brownish appearance may be alternated with concentric rings of a purplish-brown color. In cankers working in older bark the color is of a reddish-brown, or purplish tint, with a tendency to concentric rings of lighter coloration at the time when the acervuli begin to form. The acervuli appear more or less in concentric order as illustrated in Figs. 2 and 10 to 12. In the spring when the healthy wood surrounding a canker begins to grow, a fissure is produced rather definitely limiting the edge of the canker. This gives to the canker a sunken appearance which is augmented by the drying out of the affected portions of the bark. This appearance is plainly shown in Figures 7 to 12. In those portions of a canker where the acervuli are fully developed it is very difficult to distinguish the perennial canker from the same stage of the apple-tree anthracnose, caused by *Neofabraea malicorticis*. As the canker matures, the dead bark may appear cracked and fissured, and in some instances breaks away from the wood. Usually, however, as the bark dries out it adheres very firmly to the underlying wood, and may become smooth and glassy, rather than cracked into rectangular pieces. Around the dead area the healthy bark begins to heal over, forming a callus layer at the time when the fungus becomes inactive. This callus at the margins of the dead bark forces its way inward, usually lifting the dead bark, at least around the borders of the canker. This gives to the canker more of a sunken appearance than the mere drying of the diseased bark will produce. During the next season of mycelial growth the fungus makes inroads on the surrounding healthy callus formed the previous year. Sometimes this additional growth reaches a width of ¾ of an inch. Usually, however, it is less than this in a lateral direction. As would be expected, however, the growth in a direction longitudinal with the branch is more rapid, causing an elliptically-shaped canker. Year after year, then, these new calluses are formed concentrically, as is so commonly described for the open type of European canker. Sometimes the old bark adheres for several years (Fig. 4), but it usually drops away after the second year (Fig. 3). In cross-sections the wood of the branch immediately below the canker is discolored for a considerable distance toward the pith. The discoloration is brown and resembles the brown in many kinds of trees below similar wounds. The perennial character of the canker is strikingly brought out in certain cross-sections which show discoloration of the wood below the various rings, or calluses formed during succeeding years of the mycelial growth. This does not extend far into the wood during the last two or three years of the progress of the canker-fungus, but we have not ascertained how far the mycelium penetrates the wood below healthy bark nor whether this is a factor in canker enlargement.

The canker continues to increase in size for several years. Cankers showing six and seven concentric calluses have been found. These are illustrated in Figs. 3 and 5. This perennial character of the canker is one of extreme importance to be considered in connection with the control measures necessary to eradicate the canker from infected orchards.

Fig. 6. Perennial canker starting at a pruning cut.
Figs. 7 and 8. Perennial cankers starting in lesions caused by woolly aphis.
Figs. 9 to 12. Perennial cankers illustrating infection through injured twigs.

DESCRIPTION OF THE FRUIT ROT

The fruit rot produced by this disease of apple trees has not proved of definite economic importance in Oregon so far as is known. Usually the fruit has been covered with the fall spray for the control of apple-tree anthracnose before picking and this may reduce to a minimum the fruit rot in storage. However, it will never be known how much of the apple-tree-anthracnose fruit rot which has been reported in the past is due to this fungus causing the perennial apple-tree canker. It perhaps should be stated at this time that for several years apples shipped to eastern markets from the Wenatchee Valley, in the state of Washington, were received with considerable rot, which has been reported as anthracnose, or, perhaps more recently, as "a false anthracnose." No apple-tree anthracnose caused by *Neofabraea malicorticis* has ever been reported from the Wenatchee Valley. Thus, since the anthracnose canker was not known in the Valley, it was believed that the reports of anthracnose rot from eastern markets could not be correct. After consideration it was found that this rot did not appear exactly the same as the rot produced by the Northwestern anthracnose, and so for a number of years pathologists and fruit inspectors have considered this as another type of anthracnose, although the exact origin of the difficulty was not discovered until this year, when D. F. Fisher found perennial canker upon Spitzenberg trees in the Wenatchee Valley.

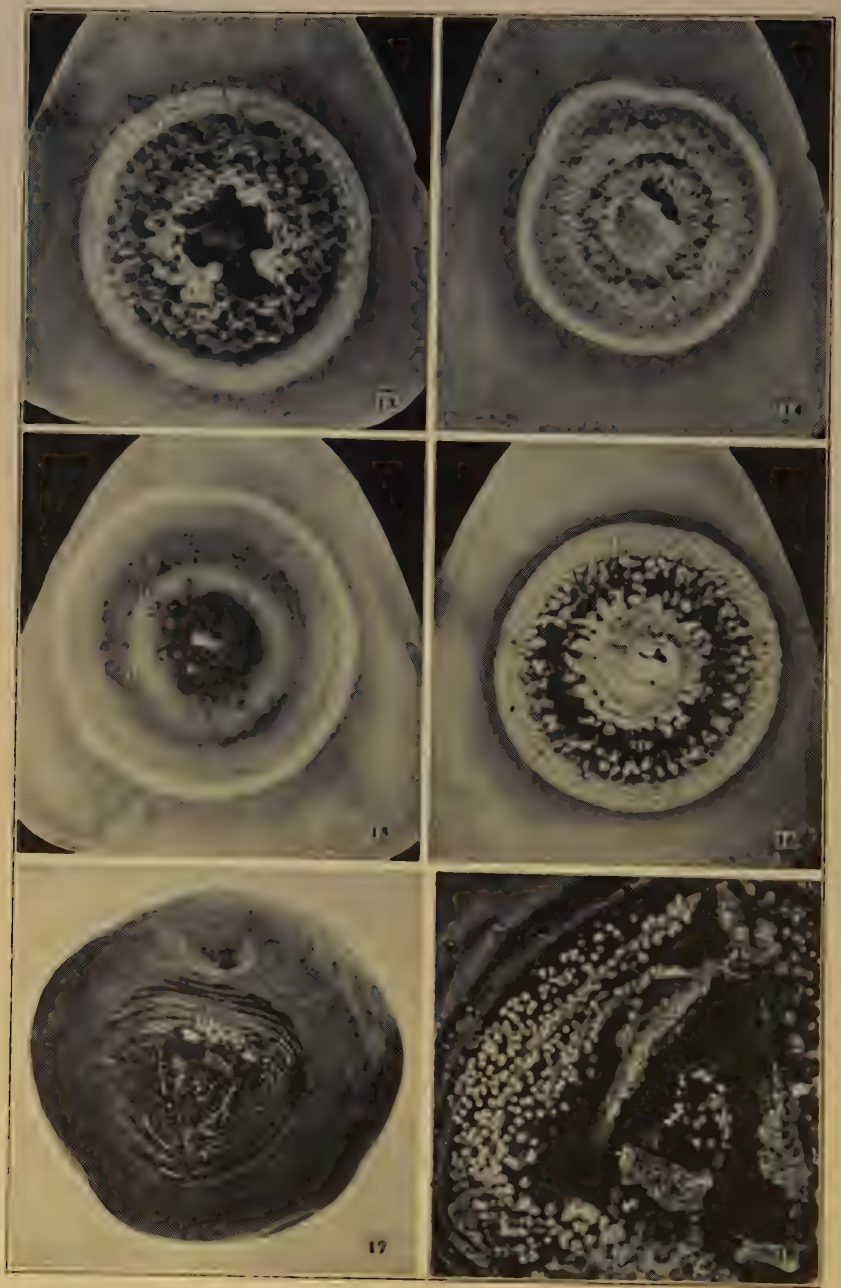
Apples inoculated with the perennial-canker organism produce a brown, soft rot. The zonation so characteristic of anthracnose rot is not apparent, although this zonation is not a constant character of anthracnose rot as a result of inoculation in the laboratory. The illustration (Fig. 17) shows a Red Astrachan apple inoculated with the perennial canker organism after twenty-eight-days incubation. The acervuli, or fruiting bodies were well developed and sporulating readily as shown in Fig. 18. The spores bore the characteristics of those from the cankers. They bear a striking contrast to the characteristically curved spores of *Neofabraea malicorticis* from apple fruit. Compared with the bitter-rot, another anthracnose of eastern and southern states, the rot produced by the perennial canker organism is much less rapid in its development, sporulates less readily on fruit lesions, has creamy white spores (in mass) while those of bitter-rot are pink, and the shape of the spores is distinct.

DESCRIPTION OF THE FUNGUS IN CULTURE

The perennial canker organism has been isolated both from apple and pear cankers by means of sterile tissue transplanted to agar slants and by the dilution plate method of isolating spore cultures. The latter method has been used the more frequently. Pure cultures have been isolated from cankers from the various localities reported below under "Specimens Examined."

Spore germination. Spore germination tests were made in hanging drops of tap and distilled water and potato-glucose agar, corn agar, and oat agar.

There were no apparent differences between the germ tubes and sporulation produced in distilled and tap water for the period of time the hanging drops were observed. Figure 19 illustrates various stages of conidiospore germination and production of secondary spores in tap



Figs. 13, Perennial canker organism growing on corn-dextrose agar, showing abundant aerial growth: 14, Apple-tree anthracnose organism growing on corn-dextrose agar. 15, Perennial canker organism growing on corn agar. Notice very narrow "halo" of starch-free agar at margin; 16, Apple-tree anthracnose organism growing on corn agar. Notice wide "halo" of starch-free agar at margin; 17, Red Astrachan apple inoculated with perennial canker organism, after twenty-eight days incubation. Notice rot with fungus fruiting; 18, Portion of rot shown in Fig. 17, enlarged 3½ diameters to show fruiting bodies of fungus.

water. Germ tubes begin to appear in three to four hours and simultaneously the spores become one-septate where one germ tube is thrown out, but become one- or two-septate where two or more germ tubes are produced. The conidia which are usually indistinctly, if at all, granular usually become netted vacuolate and more distinctly granular when germination begins. The germ tubes are produced near the end of the spore, usually slightly to one side, or near a septum. They become septate, producing secondary spores just below the septa in a more or less alternate or spiral fashion. These secondary spores are produced in succession from the same point, but in such a dilute medium as tap water, the spores become disconnected and float away. Secondary spores produced in water are 3—6 x 1—1.5 microns, ovoid to ellipsoid, while those produced in agar are 5—10 x 1.5—2 microns, ellipsoid and although the latter are produced successively from the same point they are crowded aside and held in groups in the hard medium, as illustrated in Fig. 20. The germination and septation in agar is similar to that described above for water cultures. The production of secondary spores in agar cultures is very similar in the three fungi, which cause apple-tree anthracnose, bitter-rot, and perennial canker.

Culture media. The organisms concerned in the three diseases just mentioned have been grown in pure cultures on the following media: Czapek's solution, Richard's E solution, apple and sweet clover stems, potato-glucose agar, corn-meal agar with and without dextrose, and oatmeal agar with and without dextrose. It was soon learned that the perennial canker fungus was more closely like anthracnose in culture while the bitter-rot organism is easily distinguishable. A thorough discussion of the physiology of the perennial canker organism as studied in culture will be reserved for a future publication, but some of the points of difference between this organism and apple-tree anthracnose should be pointed out here. These two fungi react to culture media quite similarly in many respects and are quite sensitive to changes in nutrition. For this reason the growth characters of either organism may vary on two different lots of the same medium made up according to the same formula, for it is not usual to get the same exact proportions in two instances. However, when several cultures of the two organisms on the same lot of a medium are observed over a period of twenty days or more, some few striking differences are apparent. Neither organism grows well in Czapek's or Richard's E solutions. The hard agar media are more conducive to growth and sporulation. The reactions of the two organisms on oat and corn agar are very similar and some of the growth reactions on the latter will be described. The growth reactions described immediately below are illustrated in Figs. 13 to 16. The anthracnose organism grows well whether dextrose is given or not. When corn-meal without dextrose supplies the nutrient the diastatic activity, as shown by the clear "halo" of starch-free agar immediately surrounding the mycelium (Fig. 16), is very positive. With this liberation of assimilable carbohydrate the fungus vegetates abundantly as illustrated by the prolific mycelial growth. When additional carbohydrate in the form of dextrose was given, vegetative growth was abundant without noticeable diastatic activity (Fig. 14). On the other hand, the vegetative growth and diastatic activity of the perennial canker organism is less apparent when dextrose is not

given than is true in the case of anthracnose (Fig. 15). When dextrose is given, however, the perennial canker organism vegetates as abundantly as does anthracnose (Fig. 13). The writers are now conducting further experiments with these two organisms to learn whether anthracnose also possesses a greater power than the perennial canker organism to hydrolyze other higher carbohydrates to assimilable forms and to reduce other unavailable foods to available forms. Surely in nature the anthracnose organism is a much more virulent parasite than the perennial canker organism, which is perhaps due to the greater power of the former to penetrate the bark because of certain of these enzymic properties.

THE CLASSIFICATION OF THE CAUSAL ORGANISM

The fungus causing perennial canker is typical of those species grouped under the form-genera, *Gloeosporium* and *Myxosporium.* Since the organism concerned in this bulletin causes both the canker of the bark and the rot of the fruit of apple, sporulating upon both, and since no perfect spore stage has been discovered, we have chosen to include it in the form-genus, *Gloeosporium,* rather than *Myxosporium,* to which are referred only those species inhabiting bark. Since the species is evidently undescribed we propose the name, *Gloeosporium perennans* sp. nov., of which a formal description with notes concerning distribution and specimens examined are included in the accompanying footnote.[1]

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[1]**Gloeosporium perennans** Zeller and Childs, sp. nov.

Acervuli originating subepidermally or deeper, erumpent, circular, irregular when coalescing, minute, 400—700 microns in diameter, (larger when coalescing), thickness from substratum variable, 250—600 microns, drying "tawny" to "mummy brown" (Ridgway), lighter when moist or freshly erumpent, at first composed of an erect cylinder of sterile, hyaline hyphae, which is later surrounded by conidiophores and finally submerged by conidiophores; *conidiophores* divergent, suberect, branched, septate, hyaline; *conidia* hyaline, irregular in shape and size, mostly ellipsoid, usually larger at one end, seldom slightly curved, 12—20 x 4—6 microns; producing secondary conidia in culture; *secondary conidia* hyaline, variable in size, 3—10 x 1—2 microns, ovoid to ellipsoid, sometimes curved.

Causing a perennial canker of the bark of *Pyrus malus,* to a less extent on *P. communis,* and fruit rot of the former.

Known distribution: Oregon, Washington, and British Columbia.

Specimens examined: British Columbia: Okanogan Center, *H. H. Evans* (in O. A. C. Herb., 4835).

Washington: Chelan county, Wenatchee, *D. F. Fisher* (in O. A. C. Herb., 4838, and Zeller Herb., 6839); Skamania county, Husum, *W. B. Rine* (in O. A. C. Herb., 4836, and in Zeller Herb., 6845); Spokane county, *F. C. Neilson* (in O. A. C. Herb., 4837, and Zeller Herb., 6849), *D. F. Fisher* (in Zeller Herb., 6850).

Oregon: Benton county, Corvallis, *C. E. Owens* (in Zeller Herb. 6833), *S. M. Zeller* (in O. A. C. Herb., 4840, and in Zeller Herb., 6835); Monroe, *S. M. Zeller* (in Zeller Herb., 6846); Hood River county, Hood River, *Leroy Childs* (in O. A. C. Herb., 4841, and Zeller Herb., 6847), *F. M. Green* and *S. M. Zeller* (in O. A. C. Herb., 4839), *Harry E. White* (in O. A. C. Herb., 4843), *S. M. Zeller* and *Leroy Childs* (in O. A. C. Herb., 4844); Parkdale, *Leroy Childs,* type (in O. A. C. Herb., 4845); Linn county, Brownsville, *Oren Stratton* (in O. A. C. Herb., 4846); Marion county, Salem, *H. P. Barss* (in O. A. C. Herb., 4847); Umatilla county, Milton, *A. R. Kirk* (in O. A. C. Herb., 4848).

Fig. 19. Germinating conidia of the perennial canker organism, showing septation and microconidia produced in water. X 770.

Fig. 20. Same as Fig. 19 but produced in corn agar. X 770.

Fig. 21. Secondary spores of the perennial canker organism produced in culture. X 770.

Fig. 22. Conidia of the perennial canker organism produced on apple canker. X 770.

Fig. 23. Conidia of apple-tree anthracnose produced on canker. X 770.

HOW DO PERENNIAL CANKER AND APPLE-TREE ANTHRACNOSE DIFFER?

Several differences between these two cankers have been pointed out in preceding paragraphs but it perhaps would be well to reiterate them here in rather concise statements. In their early stages the two cankers look very much alike. The following are the distinctions which may be made:

1. The perennial canker is a wound parasite infecting through wounds of various causes such as pruning cuts, or any other mechanical injury to the bark, lesions caused by other cankers such as anthracnose and European canker, winter injured bark and the lesions produced by such insects as woolly aphis (Figs. 1 to 12). On the other hand, anthracnose is a very much more virulent parasite, usually having its incipient infections through uninjured bark.

2. The perennial canker develops year after year by the spread of the fungus in the healthy tissues surrounding the canker of the previous season (Figs. 3 and 5) while anthracnose does not spread farther than the limits of the first year's growth, although the fungus lives in the dead tissues of a canker through the second year when the spores of the perfect stage are formed and discharged.

3. The conidiospores in the two organisms are distinct, those of anthracnose having a characteristic curve or hook (Fig. 23), while those of the perennial canker organism are generally ellipsoid although variable in shape and size, as given in the description (Fig. 22).

4. The two organisms react to certain culture media in distinct ways. The chief distinction in this respect, so far discovered by us, is the more active diastatic power of the anthracnose organism (Figs. 13 to 16).

ECONOMIC IMPORTANCE AND CONTROL MEASURES

On account of the nature of the injury produced by this disease the losses due to it are difficult to estimate. In many large orchards of the Hood River Valley, however, the disease has done extremely serious damage. Branches from the small one-year-old twigs up to scaffold branches four to six inches in diameter may be girdled because of the frequency of coalescing cankers. In some of the orchards where infection is at its worst more than 300 cankers were counted on a tree not more than 15 years old. The cankers vary in size according to their age and the size of the branch affected. On healthy branches cankers may be found up to 10 inches in length but in case of infection following winter injury affected bark may extend for considerable lengths. Because of the perennial nature of the disease the cankers must be thoroughly cleaned out by cutting out the individual cankers or they will continue to become an increasing source of infection. Some growers in districts where perennial canker has become wide-spread declare that it is useless to attempt to clean up an orchard where cankers are so frequent on trees. Perhaps this is an extreme attitude, nevertheless the wholesale removal of cankers from large trees where scores of cankers occur is an expensive and laborious operation, providing the surgical methods are

done adequately and carefully enough to effect sure eradication. And it would seem that the perennial nature of the disease would make this process of eradication the only feasible one.

There appears to be the possibility of a definite relationship between the woolly aphids to infection and growth of the canker. Fully 90 percent of the cankers examined have been heavily infested by this insect. Old, sound, pruning wounds on infected trees are, so far as observed, always free of the aphids or galls caused by them. Water sprouts infested with aphids usually die as a result of the presence of perennial canker while no such infection or resulting effect takes place on aphid-free sprouts. Further study may show that woolly aphids have nothing to do with the advance of the disease, but as a preliminary precautionary measure, control of the aphids is suggested. Exposed woolly aphids can be controlled by the application of Black Leaf 40, 1 part to 1,000 parts of water, plus calcium caseinate spreader, 2 parts to 100 parts of water. Preferably this should be applied as soon as the insects begin to appear on the shoots. This period in their development is usually reached after the middle of July.

The liberal use of bordeaux mixture may assist somewhat in checking the advance of the disease because those orchards which have been well sprayed, particularly with the bordeaux-oil combination, are in better shape than those receiving no spray. However, satisfactory control of perennial canker has not been obtained in tests being carried on at Hood River for the control of anthracnose *(Neofabraea malicorticis)*. These tests have involved spring, summer and fall application of bordeaux mixture and have indicated that measures other than the application of this fungicide will be necessary if control is to be obtained. For the present, at least until the control of the disease is better understood, one thorough application of bordeaux mixture is advised, preferably the spring bordeaux-oil combination. The 6-6-50 bordeaux formula, to which should be added a good 6 to 8 percent oil spray, is suggested as an early pre-pink application. This also controls the leaf-roller. Surgery should also be resorted to, particularly in the case of large cankers or cankers located on the larger branches. Branches with many cankers (Fig. 5) and those practically girdled should be removed as a whole. In cases where individual cankers are to be removed, the discolored, affected bark should be cut well back into the healthy tissue. Probably this can be done best during early summer as cutting at this time will permit the development of a maximum callus. A good, straight-bladed knife, such as that employed for budding, has been found suitable for cutting out cankers. This should be kept sharp, as a clean, perpendicular cut into healthy bark is desirable. After a canker is well cleaned, the wood should be coated by an antiseptic. For such purposes we have been having good success with a tree paint made up in the following manner. Into any desirable amount of a bordeaux powder, such as the Sherwin-Williams Fungi Bordo, slowly stir small amounts of raw linseed-oil until a rather thick, *smooth* paint is formed. This may be applied with a paint brush. All pruning cuts or other wounds of any size should be coated for these are all sources of infection.

The Oregon Experiment Station is now working to ascertain the most practical methods of eradication and prevention, and any progress will be announced as soon as possible.

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